

# NOTES ON ORDOVICIAN MACHAERIDIA OF NEW YORK

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The finding of a complete shell of a species of *Plumulites*, described below, has led to a revision of the other genera and species from the Ordovician of New York described by the writer and formerly considered as belonging to the Cirripedia but now assembled by T. H. Withers in a new class Machaeridia that is placed with the echinoderms.

In 1914 Bather stated the position of the Paleozoic so-called Cirripedia *Lepidocoleus*, *Turrilepas* and *Plumulites* to be uncertain, adding: "Up to the present the main reason for referring them to the Cirripedia seems to be the difficulty of placing them anywhere else."

On a visit to the State Museum he told me the reasons why he and T. H. Withers had begun to consider them as related to the echinoderms.

In 1924 in his paper on The Phylogeny of the Cirripedia, Withers positively asserted that the three so-called Paleozoic cirriped genera could not be retained there, partly because of the great gap in range, the first definitely identifiable Cirripedia occurring not until the late Triassic and partly because by careful cleaning he was able to expose subcircular muscle scars on median plates of *Turrilepas* and on both series of plates in *Lepidocoleus*. Such scars occur in pedunculate Cirripedia only on the scutum and the Paleozoic fossils here referred to would have to be and were compared with the pedunculate Cirripedia on account of the great number of plates running up to sixty.

Finally in 1926 Withers brought out the Catalogue of the Machaeridia in which this group was created for the reception of the Lepidocoleidae (genus *Lepidocoleus*) and the Turrilepadidae (genera *Turrilepas*, *Deltacoleus* and *Plumulites*). This new class Machaeridia is in the catalog definitely arrayed with the echinoderms, largely on negative evidence namely that they can not be brought into agreement with chitons, annelids and cirripedes on one hand, and on the other because of the observation of a crystalline cleavage in plates of *Lepidocoleus suecicus* and *L. squamatula*.

The Machaeridia now known from the Ordovician of New York are:

*Plumulites trentonensis* Withers. Snake Hill shale. Indian Ladder beds, Pulaski shale

*Deltacoleus filosus* (Ruedemann). Snake Hill shale

*Deltacoleus multistriatus* Ruedemann. Trenton limestone and Rysedorph conglomerate

*Lophocoleus siluricus* (Ruedemann). Snake Hill shale

### AN AMERICAN PLUMULITES WITH COMPLETE SHELL

Figure 7 (1-6)

Karl A. Pauly from Schenectady sent to the State Museum in March 1937 for identification a specimen that he had collected in the Canajoharie shale between Palatine Bridge and Stone Arabia in Montgomery county, New York. It was recognized as a complete shell of *Plumulites*, the first of its kind thus far found in America. A second, less complete but larger shell was later added but most industrious search of more shale material from the locality kindly collected by Mr Pauly afforded only detached plates.

The genus *Plumulites* was originally described by Barrande (1872, p. 565) and considered by him as belonging to the Cirripedia. He described two species with complete shells, viz. *P. bohemicus* and *P. folliculum*, both from the lower Ordovician of Bohemia. To this beautiful material can be added a third species with complete shell, found in Scotland, *P. peachi* (Nicholson & Etheridge jun.), originally described as *Turrilepas*. The plates of the two genera *Plumulites* and *Turrilepas* are similar enough to have caused confusion and the reference of various species of *Plumulites* to the genus *Turrilepas*, erected by Woodward and Salter in 1865 (p. 486). With *P. peachi* the number of species which have afforded complete shells is exhausted, although T. H. Withers in his excellent Catalogue of the Machaeridia (British Museum, 1926) cites 25 species of *Plumulites* from Europe, America and Australia.

The writer, on discovering detached plates similar to those of *Plumulites* and *Turrilepas* in the Ordovician shale of New York identified them somewhat loosely with the only supposed Ordovician cirripede known at that time in America, viz. *Lepidocoleus jamesi* (Hall and Whitfield) from the Cincinnati beds. Among those figured (1901) is also one from the Middle Trenton (Snake Hill shale) at Port Schuyler near Albany, N. Y. (*ibid.*, pl. 2, fig. 11).

This has been recognized from the figure as a species of *Plumulites* by Withers and described as *P. trentonensis* (op. cit. p. 60).

The original description of this new New York species is as follows:

**Diagnosis.** Kiteshaped plates short and broad, the apical part not attenuated, and with the proximal angles widely and almost equally truncated.

**Distribution.** Middle Ordovician, Middle Trenton beds: Port Schuyler, Albany Co., N. Y.

**Holotype.** The single kiteshaped plate in the New York State Museum, figured Ruedemann, 1901, pl. 2, fig. 11 [here reproduced figure 8(2)].

**Description.** This plate is a typical kiteshaped plate of *Plumulites*. It is comparatively short and broad, the breadth being three-quarters the length, the apical half is not attenuated, the longitudinal fold comparatively wide and straight, and the proximal angles widely and almost equally truncated. Growth lines comparatively widespaced, sharply upturned near the distal and outer margins, corresponding to the width of the truncated proximal angles.

**Comparison with other species.** This plate appears to resemble most closely the species *Plumulites fraternus* (Barrande), from the Ordovician (*d3*) of Trubin, Bohemia, but more especially the plate figured (1872, pl. 20, fig. 9). *P. fraternus*, however, has the inner proximal angle more rounded but proportionately much wider.

The material from the Canajoharie shale, both complete shells and plates, agrees in the kiteshaped plates with the holotype of *Plumulites trentonensis* and the Canajoharie shale containing the new material is equivalent in age to the Snake Hill shale.

The complete specimen affords the following description:

Shell of oboval outline, 53 mm long and 37 mm wide and triangular cross section, according to Withers; composed of two rows of small median keeled heartshaped plates and two rows of larger kiteshaped plates. In the complete shell seven plates can be counted in each of the two kiteshaped series and as many were present in the two median series. Another complete shell, unfortunately partly destroyed by the breaking rock, figure 7 (3, 4) was about twice as large as the perfect specimen before us and possessed near the base also kiteshaped lateral and heartshaped median plates of nearly twice the size of those in the smaller specimen. While the largest lateral plate in the complete specimen is 4 mm long, one of the lower plates in the second specimen measures 7 mm in length and half the length in basal width. It is also obvious that these larger kite-shaped plates become more slender and pointed towards the extremity and that the latter is more sharply turned sideways or upwards. There were also more plates in each series in the larger specimen, probably twice the number.

The plate which the writer described and figured and which was made by Withers the holotype of *Plumulites trentonensis* is a smaller lateral plate, measuring 3.3 mm in length and is therefore relatively broader and straighter than the larger plates, especially of a larger specimen. There are about 7 growth lines to a millimeter in the middlesized plates. We add camera drawings of the holotype, figure 8 (3, 4), because the original drawing is slightly diagrammatic and is too straight. The median fold also is more curved than figured; it is high and very distinct and .24 mm wide. An outer narrower fold near the distal margin is very faint.

The median plates are smaller, only about 3 mm long, more asymmetric than the lateral plates, relatively broader (approximately as broad as long), subtriangular to heartshaped and provided with a median keel which, however, is not so prominent as the fold of the lateral plates and sometimes hardly noticeable. It appears also that the figure 12 of my paper [see figure 8 (1)] represents a heartshaped median plate of this species. It came from the Snake Hill beds at Mechanicville and is therefore of the same age as the holotype. Figure 7 (6) represents a fragmentary median plate with a broad keel.

The relation of the plates in *Plumulites* has been carefully described by Withers, from whom we quote:

The apices of the keeled plates forming the two median columns lie next the broad back, and along the back the admedian portions of the plates of one column alternate and intersect with those of the opposing column. Each plate overlaps the plate in front for at least one-third of its length. At the sides the keeled plates are intersected by the kiteshaped plates which meet in loose apposition, their outer margins forming the free margin along which the shell opened. The kiteshaped plates tend to alternate with those of the opposing series, and their apices do not project freely, but because of the alternation serve to form a continuous margin.

Our specimens do not afford any additional data on these relations. The shell, according to Withers, was bladeshaped and closed where the dorsal side of the plates is seen and open on the opposite side. The plates according to Withers numbered at least 20 in each series in *Plumulites*. Our specimens are therefore probably but young individuals.

Withers has pointed out that the shells of *Plumulites* were exceptionally thin and calcareous. In the Canajoharie shale only the impressions of the dorsal and ventral sides are found as all calcareous shells are dissolved in the shale. Fossils are rare in the beds containing the shells, only scattered graptolites (*Glossograptus quadrimucronatus*), brachiopods (*Lingula curta*) and ostracods (*Ulrichia*

*bivertex*) being found. The *Plumulites* plates are common enough to make the species a normal member of the impoverished bottom faunule.

*Plumulites*, together with *Lepidocoleus* and *Turrilepas*, all of which were after considerable confusion considered by authors, the present one included, as Cirripedia, have been, together with the new genus *Deltacoleus*, placed into a new group Machaeridia, which is brought under the echinoderms, partly because the forms can not be reconciled in their structure, with that of the other classes to which they have been referred, notably annelids, chitons, cystids and barnacles, and partly because of a crystalline cleavage such as we find in echinoderms, was seen in plates of a species of *Lepidocoleus* and one of *Turrilepas*. Whatever the future taxonomic position of this interesting group may become, it is certain that it should receive a distinctive group name. Several had been proposed before, namely Palaeothoracica (Stromer v. Reichenbach, 1909), Turrilepado-morpha (Pilsbry, 1916) and Protocirripedia (Jouleaud, 1916).

The range of *Plumulites trentonensis* is greater than the occurrence in the Canajoharie shale would indicate, for detached plates have also been described and figured by the writer (1926, p. 145-46, pl. 25, figs. 1-3) as *Lepidocoleus jamesi* from the Lorraine section, where they are found as "a fairly regular component of the shale faunas" in the Pulaski beds at Worthville, N. Y. It is stated there that the form ranges up to the top of the Lorraine. Before it had already been reported by the writer (1912, p. 48) from the Indian Ladder beds. It is hence safe to assume that this species ranges from Middle Trenton age to the end of Lorraine age.

*Deltacoleus filosus* (Ruedemann)

Figure 8 (13-16)

*Turrilepas* (?) *filosus* Ruedemann. N. Y. State Mus. Bul. 42, 1901, p. 577, pl. 2, figs. 13-15

**Original description.** Plates obliquely subtriangular, comparable in outline to an isosceles triangle with the apex pushed to one side; the nucleus falling into the apex, and the two legs standing nearly vertical on the slightly convex base; the lengthened side strongly convex, the shortened nearly straight; surface marked by strongly elevated, very regular concentric lines, which have multiplied more rapidly on the posterior side.

**Dimensions.** The smaller specimen measures 4 mm along the base, and 4.5 mm along the vertical side; the larger 7 mm and 9 mm in the same direction.

**Horizon and locality.** Snake Hill shale at Mechanicville, Saratoga county, N. Y.



**Remarks.** The two plates which were referred to *Turrilepas*, as a new species with doubt on account of their different outline, were collected at Mechanicville in the black shale which formerly was part of the "Hudson River shale," later was correlated with the Utica shale by the writer (1901), and is now known to be an eastern correlative of the Middle Trenton in the Appalachian geosyncline and named the Snake Hill shale.

The plates can be properly placed with the new Machaerid genus *Deltacoleus*, proposed by Withers (1926, p. 43) for forms with "shells of triangular cross section, the median plates subtriangular, keeled or angularly bent along a submedian line from the apex and rectangularly produced below, the outer plates almost flat, without a median longitudinal ridge, approaching in shape an acute-angled isosceles triangle, and with the outer proximal angle broadly rounded."

It will be seen that this generic diagnosis closely fits the two plates here figured, the smaller the median plate that is angularly bent along a submedian line, and the larger, the lateral plate, which is nearly flat save for a faint median depression, and approaches an asymmetric isosceles triangle in outline.

There is so far described only one other species, the genotype, *D. crassus* Withers from the Middle and Upper Ordovician (Llandeilian and Caradocian) of Girvan, Ayrshire, Scotland.

*Deltacoleus multistriatus* sp. nov.

Figure 8 (5-7)

*Lepidocoleus jamesi* (Ruedemann). N. Y. State Mus. Bul. 42, 1901, pl. 2, fig. 10

*Lepidocoleus jamesi* (Ruedemann). N. Y. State Mus. Bul. 49, 1901, p. 87-89, pl. 4, figs. 16-19

The writer has described plates from the Trenton limestone at Trenton Falls (1901, pl. 2, fig. 10) and from the black limestone pebbles of the Rysedorph Hill conglomerate with Trenton fossils (1901a, pl. 4, figs. 16-19) as *Lepidocoleus jamesi* (Hall and Whitfield) stating that Hall and Whitfield had already reported (1875) that they had observed their *Plumulites jamesi* in the Trenton limestone.

In a restudy of these plates it is seen that they fully agree with *Deltacoleus filusus* in the flat surface of the plates which are preserved as thick calcareous bodies, but differ markedly in size reach-

ing only one-third the size of those of *D. filusus* and possessing much finer growth lines which number 10 to 12 in 1 mm as against 6 to 7 in *D. filusus*. Differences in age or position on the complete shell would not suffice to explain these differences. We will therefore distinguish this well-marked form as *D. multistriatus*.

**Description.** Entire shell small, median plate broadly triangular, flat, about as wide as high, without distinct keel and gently convex base. Outer or kiteshaped plates, twice as long as wide, flat with rounded base. Growth lines sharply bent forward on the outer side, sharp, raised

**Dimensions.** Holotype 2.2 mm long and 2.1+ mm wide. Other median plate 1.9 mm long; kiteshaped plate 2.1+ mm long and 1.3 mm wide.

**Horizon and locality.** Holotype from Trenton limestone at Trenton Falls, N. Y., paratypes from Rysedorph conglomerate, Rensselaer, N. Y. R. Ruedemann coll. 1900

### REVISION OF POLLICIPES

When the writer discovered in the black Snake Hill shales at Mechanicville, Saratoga county, (1899) and Green Island, Albany county, (1900) a number of plates that suggested in their form the various plates of the capitulum of a barnacle, he did not hesitate (1901) to refer these to the genus *Pollicipes* as *P. siluricus* (in reference to the "Lower Silurian," now Ordovician), pointing, however, to the "enormous gap existing between the appearance of the Lower Siluric type and the next Upper Triassic (Rhaetic) representatives of these genera."

F. A. Bather shortly after (1901) in a review of my paper (1901) pointed out that the gap is not so great as I surmised as a Silurian species, *P. signatus* was described by Aurivillius from Sweden in 1892.

Since that time the cirripede-nature of all Paleozoic fossils referred there has been placed in doubt by Withers, and it has been stated by him (1926, p. 72) that *Pollicipes aurivillii* (Moberg) [formerly *P. validus* Aurivillius] is "certainly not a scutum of a *Pollicipes*." While that author, not having seen the specimens of *P. siluricus*, cautiously leaves this form out of the discussion, it is obvious that the generic term *Pollicipes* can not be retained for the group of plates united by the writer under *P. siluricus* by comparison with the capitulum of a *Pollicipes*.

A restudy of the plates leads to the inference that the larger number, viz. figures 16-23, may well be considered as belonging to one form, probably also a Machaeridian. One of these plates shows even distinctly the two muscle scars, observed by Withers on median plates of *Turrilepas* and both series of plates of *Lepidocoleus*. As the form can not be placed into one of the genera so far described, we propose to erect for it the genus *Lophocoleus*.

*Lophocoleus* gen. nov.

(*lophos*, keel; *koleos*, sheath)

**Diagnosis.** Shell of triangular cross section, the median plates short, subtriangular, keeled and sharply angularly bent along a submedian line from the apex and rectangularly produced below, the outer plates highly arched, with a strong median keel and lateral folds, with a long angular base and the outer proximal angle obtuse.

**Genotype:** *Lophocoleus siluricus* (Ruedemann)

This genus is principally distinguished from the others by the strong median keel; the relatively smooth surface, lacking the strong growth lines, and the horn-shaped lateral plates, the sides of which approach inward producing a strongly angular base.

*Lophocoleus siluricus* (Ruedemann)

Figure 8 (8-12)

*Pollicipes siluricus* Ruedemann. N. Y. State Mus. Bul. 42, 1901, pl. 2, figs. 16-25

**Description.** Kiteshaped plates short and broad, the apical part turned inward; with a broad high keel, a curved fold near each of the proximal angles, extending towards the beak. Proximal angles subrectangular, basal angle obtuse, basal margins gently convex. Surface fairly smooth, with very fine growth lines and faint traces of lines running parallel to the keel

Median plate subrhomboidal in outline, with a strong median keel and two accessory depressed lines or folds on each side. Outer margins straight, forming a nearly right angle at the beak, inner margins convex, together approaching a semicircle. Surface smooth, but with indications of strong growth lines at the outer margin (ended too abruptly in drawing)



**Horizon and locality.** Ordovician Snake Hill shale at Green Island, Albany county, N. Y., and Mechanicville, Saratoga county, N. Y. R. Ruedemann coll. 1900

**Remarks.** We consider the originals of nos. 8, 9, 10 as the types of this species, with no. 9 as the holotype. The majority of the specimens (nos. 8, 11 of our figures) were taken out of a little nest of fossils, a few square yards in size, on the bank of a branch of the Mohawk river. This peculiar nest of fossils contained a variety of small fossils in an otherwise rather barren shale and the *Lophocoleus* plates were all found in close proximity. The plates are all preserved as impressions only, mostly of inner surfaces, as notably the specimen with the muscle scars, figure 8 (10). It is therefore possible that the outer surfaces were not as smooth as is suggested by the impressions. The single supposed median plate, figure 8 (12) is an impression of the outer surface, and it retains traces of stronger growth lines.

It appears that the younger kiteshaped plates were broad and short, and that the plates became increasingly slender with growth; figure 11 would indicate that the very largest plates were relatively narrow and possessed a long straight inner margin.

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## Explanation of Figures

### Figure 7

1 to 6 *Plumulites trentonensis* Withers

- 1 Photograph of complete shell, x6
- 2 Camera drawing of same, x6
- 3 Photograph of larger, but incomplete shell, x6
- 4 Camera drawing of same, x6
- 5 Median plate. Camera drawing, x5
- 6 Median plate. Photograph, x5

All specimens are from the Ordovician Canajoharie shale near Broadalbin, Montgomery county and were collected by Karl A. Pauly, 1937. The types are in the New York State Museum.

### Figure 8

1, 2, 3, 4 *Plumulites trentonensis* Withers

1, 2 Copies of Ruedemann's original drawings (1901, pl. 2). No. 2. Withers' holotype

3, 4 Camera drawings of cast and mold of the holotype, x5

Ordovician Snake Hill shale at Port Schuyler near Albany, N. Y. R. Ruedemann coll. 1900

5, 6, 7 *Deltacoleus multistriatus* sp. nov.

5 Holotype, x7. Median plate. (same as Ruedemann 1901, pl. 2, fig. 10). Trenton limestone, Trenton Falls, N. Y.

6, 7 Kiteshaped, outer plates. Paratypes, x12. Rysedorph conglomerate, Rysedorph Hill, Rensselaer county, New York. R. Ruedemann coll. 1900

8, 9, 10, 11, 12 *Lophocoleus siluricus* (Ruedemann)

8, 9, 10, 11 Kiteshaped plates. No. 9, holotype; Nos. 8, 10, 11, Paratypes. No. 12 Median plate, paratype. All x10

13, 14, 15, 16 *Deltacoleus filosus* (Ruedemann). Nos. 13, 15, original drawings of cotypes, x10; Nos. 14, 16, camera drawings of same (number 14 opposite side), x12

Ordovician Snake Hill shale, Mechanicville, Saratoga county, N. Y. R. Ruedemann coll. 1900. All originals are in the New York State Museum



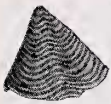
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Figure 7

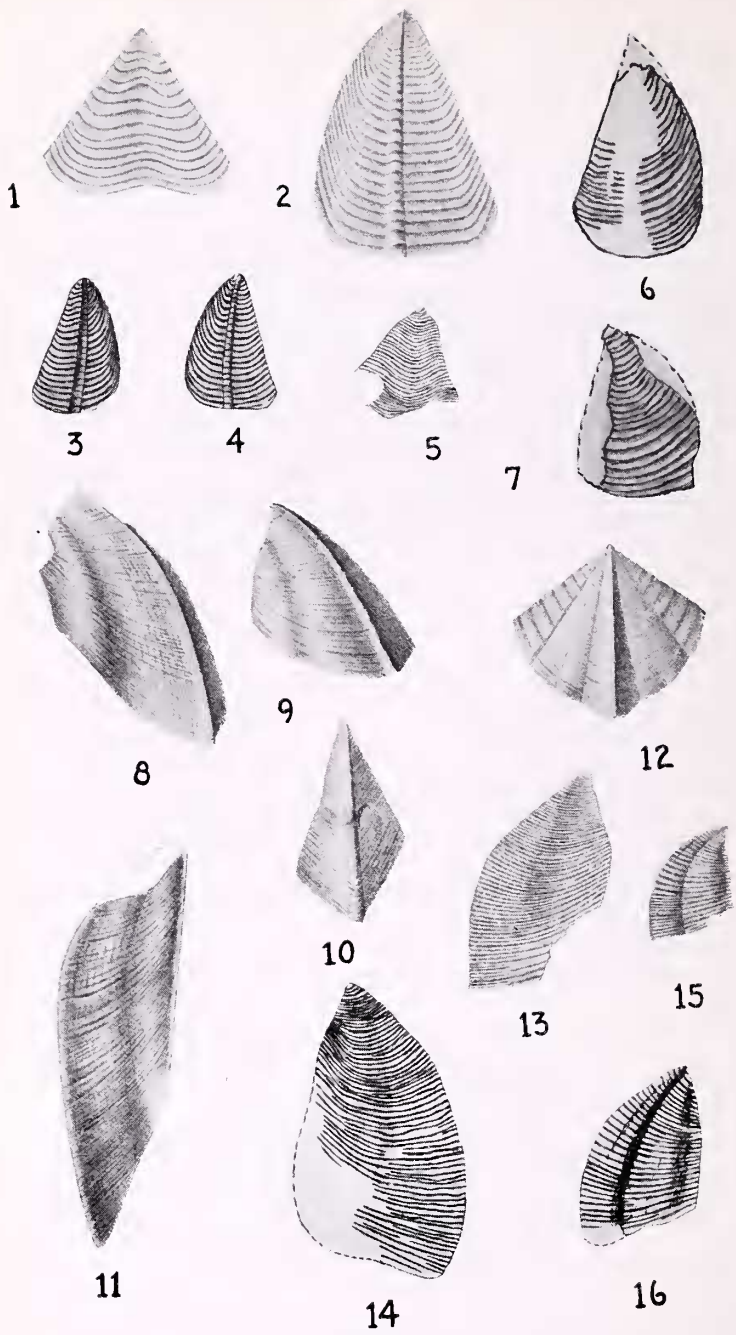


Figure 8